



Primary Standards Laboratory Metrology Program

Fact Sheet

Vacuum

The Primary Standards Laboratory (PSL) maintains a wide variety of primary vacuum standards to assure accurate and traceable measurements for its customers.

Primary vacuum standards consist of capacitance diaphragm gages (CDGs), spinning rotor gages (SRGs), ionization gages (IGs) and piston gauges with direct traceability to the National Institute of Standards and Technology (NIST).

We use an automated Forced-Balance Piston Gauge to calibrate transducers such as CDGs in differential or absolute mode. Above a base pressure of 10^{-6} Pa (10^{-8} torr), pressures can be generated with most inert gases. We perform calibrations on this system for pressures ranging from 1 Pa to 1 kPa (0.01 to 1000 torr).

Direct comparison calibrations for SRGs and IGs are made on a semi-automated high-vacuum calibration system in the high-to intermediate-vacuum regime with NIST-calibrated spinning rotor gages and ionization gages. Generating pressures above a base of 10^{-9} Pa (10^{-11} torr), calibrations can be performed with nitrogen for pressures ranging from 10^{-6} to 10 Pa (10^{-8} to 10^{-2} torr).

The PSL has an intrinsic low-pressure standard (an ultrasonic interferometer manometer) designed and built by NIST. It provides high accuracy in the area of low-vacuum measurements.

Currently under development are several fundamental calibration systems. A high-vacuum orifice-flow standard is being developed at the Primary Standards Laboratory. NIST has been supported by the PSL to develop a multi-orifice intermediate vacuum standard and

a low-flow generator. These systems are anticipated to be operational in 2005

Capabilities

Ionization Gage Reference for direct comparison

Range	Best Uncertainty (\pm) %, k=2	Remarks
1.3×10^{-6} Pa < reading $\leq 1.3 \times 10^{-5}$ Pa	4.8	N ₂ ; 10^{-8} torr range
1.3×10^{-5} Pa < reading $\leq 1.3 \times 10^{-4}$ Pa	4.7	N ₂ ; 10^{-7} torr range
1.3×10^{-4} Pa < reading $\leq 1.3 \times 10^{-3}$ Pa	4.7 - 2.5	N ₂ ; 10^{-6} torr range

Spinning Rotor Gage Reference for direct comparison

Range	Best Uncertainty (\pm) %, k=2	Remarks
1.3×10^{-4} Pa < reading $\leq 1.3 \times 10^{-3}$ Pa	4.3 - 2.1	N ₂ ; 10^{-6} torr range
1.3×10^{-3} Pa < reading ≤ 1.3 Pa	2.1	N ₂ ; 10^{-5} torr to 10^{-3} torr range
1.3 Pa \leq reading ≤ 13 Pa	2.2	N ₂ ; 10^{-3} torr range

Capacitance Diaphragm Gages Reference for direct comparison

Range	Best Uncertainty (\pm) %, k=2	Remarks
1.3×10^{-1} Pa \leq reading ≤ 13.3 Pa	2.1 - 0.7%	N ₂ ; 0.1 torr range

Capacitance Diaphragm Gages Reference using Forced-Balance & Dead Weight Piston Gauges

Range	Best Uncertainty (\pm) %, k=2	Remarks
0.3 Pa \leq reading ≤ 6.0 Pa	30 ppm + 0.0025 Pa	N ₂ ; 0.1 torr range
6.0 Pa \leq reading ≤ 15.0 kPa	30 ppm + 0.008 Pa	N ₂ ; 0.1, 1, 10, and 100 torr ranges
15 kPa \leq reading ≤ 133.3 kPa	31 ppm	N ₂ ; 1000 torr range



The vacuum lab can accommodate one-of-a-kind calibrations. we provide consultation to our customers on proper selection, maintenance, and use of standards and transducers.

Major Resources

- Automated Forced-Balanced Piston Gauge
- Semi-automated, direct-comparison high-vacuum system
- Intrinsic ultrasonic interferometer manometer (expected to be operational in 2005)
- Fundamental multi-orifice, high vacuum to intermediate vacuum system



High Vacuum Calibration System

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